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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENT

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 14 FEB 2005

WIPO PCT

Applicant's or agent's file reference P2049PC00	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/NO 2003/000405	International filing date (day/month/year) 03.12.2003	Priority date (day/month/year) 03.12.2002
International Patent Classification (IPC) or national classification and IPC A61B 5/103, A61B 5/05		
Applicant Idex ASA et al		

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 7 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
 - ☒ (sent to the applicant and to the International Bureau) a total of 3 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

- This report contains indications relating to the following items:

<input checked="" type="checkbox"/> Box No. I	Basis of the report
<input checked="" type="checkbox"/> Box No. II	Priority
<input type="checkbox"/> Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/> Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/> Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/> Box No. VI	Certain documents cited
<input checked="" type="checkbox"/> Box No. VII	Certain defects in the international application
<input type="checkbox"/> Box No. VIII	Certain observations on the international application

Date of submission of the demand 02.07.2004	Date of completion of this report 25.01.2005
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Anna Malmberg /OGU Telephone No. +46 8 782 25 00

Form PCT/IPEA/409 (cover sheet) (January 2004)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NO 2003/000405

Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

- ☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1-13 _____ as originally filed/furnished
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☒ the claims:
- pages _____ as originally filed/furnished
- pages* _____ as amended (together with any statement) under Article 19
- pages* 14-16 _____ received by this Authority on 08.11.2004
- pages* _____ received by this Authority on _____
- ☒ the drawings:
- pages 1-4 _____ as originally filed/furnished
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (specify): _____
- ☐ any table(s) related to the sequence listing (specify): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (specify): _____
- ☐ any table(s) related to the sequence listing (specify): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

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Box No. II Priority

1. ☐ This report has been established as if no priority had been claimed due to the failure to furnish within the prescribed time limit the requested:
- ☐ copy of the earlier application whose priority has been claimed (Rule 66.7(a)).
- ☐ translation of the earlier application whose priority has been claimed (Rule 66.7(b)).
2. ☒ This report has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rule 64.1). Thus for the purposes of this report, the international filing date indicated above is considered to be the relevant date.
3. Additional observations, if necessary:

Since the priority document only disclose a sensor assembly without any disclosure of any means for comparison of the measured impedances by determining the slope of a curve describing the relationship between the imaginary and real parts as a function of applied frequency, it follows that claims 3 and 10 of the application, which are directed to such a comparing means, are not entitled to the claimed priority dates, but only to the filing date, i.e. 3 December 2003.

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-10</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-10</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-10</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

This report is based on the claims as filed with the letter of 2004-11-08.

Prior art

D1: WO 0019894 A1
D2: WO 9923945 A1
D3: US 2001005424 A
D4: US 5953441 A

Document D1 discloses a finger detection apparatus which disclose electrodes in the front of a probe connected by wires to control circuitry. The electrodes can be used in pairs to measure the response of an electrical pulse to the tissue and use the result to determine if the tissue is a real live finger or not. A four electrode measurement can be performed where a pair of electrodes is used to apply current and a second pair is used to measure the voltage drop induced in the tissue which provides data on the conductivity and phase angle characteristics at different frequencies. The electrodes can be switched so that different electrodes can be chosen as pairs. (See for example page 3, line 35 - page 5, line 8, page 6, line 20 - page 7, line 11, page 8, line 31 - page 10, line 9, page 14, line 17 - page 15, line 35 and figures 1a, 1b, 4 and 5.)

Document D2 discloses a skin impedance imaging system which discloses a probe having an electrode which is intended for movement over a patient's skin and a reference electrode applied to the patient's skin. When using alternating currents

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V.

1(2)

of different frequencies supplied to the probe and/or reference electrode, the voltage changes are measured to provide a measure of the impedance of the skin, thereby providing an indication of the induced or pathological changes in the skin. There is also an embodiment where there are a multiple of electrodes employed to measure the impedance of the skin. (See for example page 4, line 9- page 5, line 16, page 6, line 4-12, page 7, line 15-27, page 8, line 25 - page 9, line 17 and figure 2.)

Document D3 discloses a method for detecting the impedance of a human skin surface measured as a function of frequency of an electric AC voltage. The characteristic curve is compared with a reference characteristic curve. If the characteristic curve substantially corresponds to the reference characteristic curve, the skin surface is recognized as belonging to living tissue. (See the whole document.)

Document D4 discloses a fingerprint sensor including an array of impedance sensing elements for generating signals related to an object positioned adjacent thereto and a spoof reducing circuit for determining whether or not an impedance of the object corresponds to a live finger or not. The spoof reducing circuit may detect complex impedances among others. (See for example the abstract.)

Statement of reason

The claimed invention relates to a sensor assembly and a method for determining the condition of a structure, especially for confirming if a measured fingerprint is on a live finger. The sensor assembly constitutes at least four electrodes, and one chosen pair (i.e. two electrodes) of the four electrodes works as current supply electrodes and a second pair of the four electrodes, of which one electrode does not constitute a current supply electrode, constitutes pickup electrodes, and a measuring instrument, which measures the impedance between the electrodes, is coupled to said four electrodes. By alternating the coupling of at least the current supply and the measuring instrument to different electrode pairs, characteristic values of the impedance can be measured at different depths in the structure, such as a live finger, and thus compensate for variations in e.g. the stratum corneum thickness.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V.

2(2)

Neither D1 nor D2 teach to use a pair (i.e. two) of the four electrodes as current supply electrodes and to use a second pair of the four electrodes as pickup electrodes, of which second pair one electrode does not constitute a current supply electrode. Neither does D1 nor D2 teach to alternate the coupling of at least one current supply and the measuring instrument to different electrode pairs with different distances between them.

The documents D3 and D4 are of no relevance regarding the novelty or inventive step of claims 1-10.

The invention according to claims 1-10 is thus novel and is considered to involve an inventive step. The invention according to claims 1-10 is industrially applicable.

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Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

The features of the claim/s are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

According to the requirements of Rule 11.13(1) reference signs not appearing in the description shall not appear in the drawings, and vice versa. This requirement is not met in view of the reference sign 14 and 15.

C l a i m s

1. Sensor assembly for determining the condition of a structure, especially for confirming if a measured fingerprint is on a live finger, by measuring characteristics of close to the structure surface, the sensor comprising
- 5 a current source
- at least four electrodes at chosen positions relative to each other, said positions providing at least two relative distances between the electrodes, wherein a chosen first pair of said at least four electrodes constitutes current supply electrodes, and a chosen second pair of said at least four electrodes, of which at least one does not
- 10 constitute a current supply electrode, constitutes pickup electrodes,
- a measuring instrument coupled to said at least four electrodes for measuring the impedance between said chosen pair of pickup electrodes for providing a value characterizing the structure,
- storage means for storing a predetermined set of values characterising a
- 15 chosen condition for said structure, and
- the sensor also comprising calculation means for comparing said characteristics from each of said at least one pair of pickup electrodes with said set of predetermined values for detecting if said structure is in a certain condition, and the sensor assembly is adapted to alternating coupling of at least one current supply and
- 20 measuring instrument to different electrode pairs with different distances between them, for measuring characteristic values at different depths in said structure.
2. Sensor assembly according to claim 1, wherein the supplied current is oscillating within a chosen frequency range.
- 25
3. Sensor assembly according to claim 2, comprising measuring means for measuring the impedance at each pickup electrode, and wherein said calculation means comprises comparing means for comparing the imaginary and real parts of the impedance signals as functions of the applied frequency, by determining the slope of the
- 30 resulting curve, and comparing this slope with a predetermined set of slopes indicating a live finger.

4. Sensor assembly according to claim 1, wherein the distance a first of said supply electrodes and sad first pickup electrode is less than 1mm.
5. Sensor assembly according to claim 1, comprising control means for
5 interchanging the roles of the electrodes such that the roles of the pickup and supply electrodes may change sequentially for varying the relative positions between the sensors and thus the measured characteristics of the surface.
6. Sensor assembly according to claim 5,, comprising measuring means for
10 measuring the phase of the signal at each pickup electrode, and wherein said calculation means comprises comparing means for comparing the distance between the pick up and supply electrode at chosen frequencies with the corresponding phase of the signal, and comparing these parameters with a predetermined set indicating a live finger.
- 15 7. Sensor assembly according to claim 1, wherein the pickup electrodes are constituted by sensor elements in a fingerprint sensor array.
8. Method for characterizing the condition of a structure close to its surface, e.g the electrical characteristics of two outer parts of the skin, i.e. the stratum corneum
20 and the viable skin, by using at least four electrodes coupled to the surface and with at least two different distances between the electrodes, comprising the following steps:
- applying a current or voltage to the skin between at a first pair of current supply electrodes,
 - measuring the impedance between a second pair of pickup electrodes, of which
25 at least one is not a current supply electrode, and calculating electrical characteristics related to this,
 - sequentially changing the roles of the electrodes, thus to apply a current between a second pair of current supply electrodes and thus to perform measurements with at least two different distances between pickup electrodes and/or current
30 supply electrodes, respectively,
 - comparing the measured impedances with a predetermined set of values characterising at least one condition of the structure,

- determining the condition of the structure based on the comparisons between the measured values and the predetermined set of values.

9. Method according to claim 8, wherein the step of applying a current or
5 voltage between the two electrodes comprises the application of a varying frequency signal and measuring the impedance between one of said current supply electrodes and at least two pickup electrodes positioned at chosen distances from said current supply electrode.
- 10 10. Method according to claim 9, wherein the comparison of the measured impedances by determining the slope of the curve describing the relationship between the imaginary and real parts of the measured impedance signal as a function of applied frequency, and comparing the determined slope with a predetermined set of values . characterizing a live finger.